REMARKS

Please reconsider the application in view of the above amendments and the following remarks. Applicant thanks the Examiner for carefully considering this application.

Disposition of the Claims

Claims 2-23, 25-38, 40, 42-43, and 45-48 are pending in this application. Claims 45, 46, 47, and 48 are independent. The remaining claims depend, directly or indirectly, from claims 45, and 46.

Claim Amendments

Claims 3, 11-13, and 45-48 have been amended in this reply to clarify the present invention recited. Claim 3 has been amended to correct a typographical error. Claims 11-13 have been amended to more clearly recite a ratio of the sum of the radial forces to the applied weight-on-bit. Claims 45-48 have been amended to include a step of outputting. No new matter has been added by way of these amendments, as support may be found in, for example, paragraph 35 on pages 8-9, paragraph 52 on page 14, and paragraph 71 on page 20.

Drawings

The drawings were objected to because Figures 9A-9C were indicated as being of poor quality and difficult to read. Amended drawings are enclosed in this reply. In particular, Figures 9A-9C have been amended to improve the line quality. Thus, Applicant respectfully requests withdrawal of this objection.

Double Patenting

Claims 2-23, 25-38, 40, 42-43, and 45-48 stand rejected on the grounds of non-statutory obviousness type double patenting as being unpatentable over claims 1-14 of U.S. Patent No. 6,785,641.

Additionally, claims 2-23, 25-38, 40, 42-43, and 45-48 stand rejected on the grounds of non-statutory obviousness type double patenting as being unpatentable over claims 23-45 of U.S. Patent No. 6,516,293.

Pursuant to 37 C.F.R. §1.321, the undersigned encloses herewith a terminal disclaimer with respect to the patents above, rendering this rejection moot. Accordingly, withdrawal of the double patenting rejection is respectfully requested.

Rejections under 35 U.S.C. § 101

Claims 2-23, 25-38, 40, 42-43, and 45-48 are rejected under 35 U.S.C. § 101 as being directed to non-statutory subject matter. Claims 45-48 have been amended in this reply. To the extent that this rejection may still apply to the amended claims, this rejection is respectfully traversed.

Claim 45, as amended, recites a method for designing a drill bit, including determining radial forces acting on a selected drill bit during simulated drilling, evaluating the radial forces based on at least one selected criterion, adjusting at least one parameter of the selected drill bit based on the evaluating, outputting a drill bit design based on the evaluating and the adjusting.

Claim 46, as amended, recites a method for designing a bottomhole assembly, including determining radial forces acting on a bottom hole assembly during simulated drilling, said bottomhole assembly including a drill bit, evaluating the radial forces based on at least one

selected criterion, adjusting at least one parameter of the bottom hole assembly based on the evaluation, outputting a bottom hole assembly design based on the evaluating and the adjusting.

Claim 47, as amended, recites a method for designing a bit, including determining radial forces acting on a selected drill bit during a simulated drilling in selected earth formation, graphically displaying the radial forces determined during the simulation, adjusting at least one parameter of the drill bit based on the graphical display of the radial forces; and outputting a drill bit design based on the graphically displaying and the adjusting.

Claim 48, as amended, recites a method for selecting a bit design, including simulating a first bit design drilling in earth formation, obtaining a first set of radial forces determined from the simulating of the first bit design, simulating a second bit design drilling in earth formation, obtaining a second set of radial forces determined from the simulating of the second bit design, evaluating the first set of radial forces and the second set of radial forces based on a selected criterion, selecting a preferred bit design based on the evaluating, and outputting the preferred bit design.

Applicant notes that a claimed invention as a whole must accomplish a practical application. That is, it must produce a "useful, concrete, and tangible result." *State Street*, 149 F.3d at 1373, 47 USPQ2d at 1601-02. Independent claims 45-48 have been amended to clarify the present invention recited. In particular, claims 45-48, as amended, include a practical application with a useful, concrete, and tangible result, as each independent claim recites a step of outputting. In particular, claim 45 recites a step of outputting a drill bit design based on the evaluating and the adjusting; claim 46 recites outputting a bottom hole assembly design based on the evaluating and the adjusting; claim 47 recites outputting a drill bit design based on the graphically displaying and the adjusting; and claim 48 recites outputting the preferred bit design.

Thus, the claimed invention is statutory. Dependent claims 2-23, 25-38, 40, and 42-43 are statutory for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Rejections under 35 U.S.C. § 112

Claims 42 and 43 stand rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. Claims 42 and 43 have been cancelled in this reply. Thus, this rejection is now moot.

Claims 11-13 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. Claims 11-13 have been amended in this reply. To the extent that this rejection may still apply to the amended claims, this rejection is respectfully traversed.

Claims 11-13 were rejected, because the Examiner asserts that the term "no more than about" is indefinite. Claims 11-13 have been amended to recite "less than or equal to." Applicant believes that claims 11-13 are now definite.

In view of the above, withdrawal of these rejections is respectfully requested.

Rejections under 35 U.S.C. § 102

Claims 2-7, 40, 42, 43, and 45-48 are rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. patent No. 6,412,577, issued to Chen ("Chen"). Claims 45-48 have been amended in this reply. To the extent that this rejection may still apply to the amended claims, the rejection is respectfully traversed.

As noted above, independent claims 45-48 are directed to a method for designing or selecting a design of a drill bit or a bottomhole assembly by evaluating determined radial

forces based on at least one selected criterion. As disclosed in paragraphs 36 and 37 on page 9 of the specification, the at least one selected criterion may include any standard by which radial force on a bit can be evaluated. The criterion may be quantitative or qualitative in nature, or a combination thereof. For example, the criteria may be a ratio of the resultant radial force to the applied weight on bit (WOB). Advantageously, embodiments of the present invention may be used to minimize radial force imbalance that may result in a whirl effect that reduces cutting efficiency of a drill bit. Further, embodiments of the present invention may potentially increase the life of a drill bit by preventing damage due to repetitive impact of the cutting structure against the walls of the wellbore during drilling.

Chen discloses a method of designing a roller cone bit that includes mapping locations of teeth that are cutting at a given time, calculating cutting area, volume, and forces for each of the teeth that is cutting at a given time, using the mapping, and adjusting an orientation of the teeth. (See claim 1.) Chen discloses a graphic display of a scraping motion for tooth that simply allows the designer to get a feel for the effect of various parameter variations. (See column 12, lines 30-35).

Chen, however, fails to teach or disclose *evaluating the radial force* acting on a drill bit or bottomhole assembly based on at least one selected criterion, as claimed in independent claims 45, 46, and 48. Additionally, Chen fails to teach or disclose adjusting at least one parameter of the selected drill bit based on the evaluation of the radial forces, as recited in independent claims 45-48. Further, Chen fails to show or suggest graphically displaying the radial forces determined during a simulation and adjusting at least one parameter of the drill bit *based on the graphical display of the radial forces*, as claimed in independent claim 47. Chen also fails to teach or disclose obtaining a first and a second set of radial forces of a first and

second bit design, respectively, and evaluating the first and second set of radial forces based on a selected criterion, as claimed in independent claim 48.

Applicant respectfully notes that in order for a claim to be anticipated, "every element and limitation of the claimed invention must be found in a single prior art reference, arranged as in the claim." *Brown v. 3M*, 265 F.3d 1349, 1351 (Fed. Cir. 2001). In view of the above, Chen fails to teach each limitation recited in independent claims 45-48, as required to support a rejection under §102. Thus, independent claims 45-48 are patentable over Chen. Dependent claims are allowable for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Rejections under 35 U.S.C. § 103

A. Claims 2-7 and 45-48 are rejected under 35 U.S.C. § 103(a) as being unpatentable over "The Operational Mechanics of The Rock Bit," by Ma, *et al.* ("the Ma book"). Claims 45-48 have been amended in this reply. To the extent that this rejection may still apply to the amended claims, this rejection is respectfully traversed.

The first chapter of the Ma book sets forth the objective of the book as follows:

> When the rock bit is studied or designed by means of this technological system, the dependence on experience will be reduced, the time for comparing design schemes will be decreased, the most calculation and optimization in the bit designing will be done by the aid of computer, and the bit engineering drawings will be drawn by computer. In short, the rate and the quality of bit design will be improved significantly. The performance design and the mechanical design of rock bit now begin to jump from the empirical to the scientific level. The main contents of the book will present those research results (p. 17 of the Ma book).

Here, the Ma book has been constructed to establish a relationship between mechanical (or geometric) design and performance design, which was previously understood solely through observation.

Chapter 5 discusses the experimental study of the interaction between a drill bit and formation the bit is drilling. In particular, section 5.5, discusses side cutting of a drill bit, wellbore deviation, and possible causes of wellbore deviation. The Ma book discloses that the various influence factors may mutually affect wellbore deviation and divides the factors into two sets: (a) mechanical problems of the drilling pipe and its accessories and (b) mechanical problems of bit side cutting. Further, Section 5.5 proposes four factors that may affect the side cutting ability of a roller cone bit, including altitude in the transition zone, the number of teeth on the outside row of the bit, tooth shape, and enlarge force, F_e, in combination with teeth structure.

The last chapter (Chapter 6) addresses the two issues of design, *i.e.*, geometrical design and performance design (pp. 227-228 of the Ma book). The Ma book characterizes the benefits of the disclosed design method:

> The new bit design technology has the following destinctive [sic] features in contrast to the traditional design method. The rock bit is a short life tool. The main approach to improving the bit performance is that the performance and life of the parts should be properly matched [to] each other. The prerequisite for this approach is to evaluate the size, load, motion, stress and strain of every part accurately. The traditional method just could not do this. It could not evaluate the velocity of tooth, the number of contacting teeth, the load distribution to parts, and only determines the sizes to the millimeter [sic] level by the projective geometry drawings. While the new method can calculate the micrometer level in size and the mm/s level in tooth velocity, if necessary. In a word, the new design technology increases the design precision, and the accuracy of most calculated data, and reduces the dependence on experience. (p. 232 of the Ma book).

While the Ma book describes the intricacies of the mechanics of a roller cone drill bit in Chapters 2-5 and provides a basic framework for roller cone drill bit design in Chapter 6, the Ma book fails to disclose iterative roller cone drill bit design methods with respect to the specific features in the specific manner, as recited in independent claims 45-48, as amended.

For example, with respect to claims 45 and 46, the Ma book fails to show or suggest evaluating radial forces based on a selected criterion and adjusting at least one parameter of the selected drill bit based on the evaluating. As disclosed in the present application, the selected criterion may include, for example, a ratio of the resultant radial force to the applied weight on bit (WOB). The Ma book fails to show or suggest a method or criterion for evaluating radial forces on a drill bit of bottomhole assembly.

Further, with respect to claim 47, the Ma book fails to show or suggest graphically displaying the radial forces determined during a simulation and adjusting at least one parameter of the drill bit *based on the graphical display of the radial forces*.

With respect to claim 48, the Ma book fails to show or suggest obtaining a first and a second set of radial forces of a first and second bit design, respectively, and evaluating the first and second set of radial forces based on a selected criterion.

In view of the above, the Ma book fails to show or suggest the present invention as recited in independent claims 45-48, as amended. Thus, claims 45-48, as amended, are patentable over the Ma book. Dependent claims are allowable for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

B. Claims 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ma in view of "Drag-Bit Performance Modeling," by Warren, *et al.* ("Warren"). Claims 8 and 9 depend, directly or indirectly, from independent claim 45. Claim 45 has been amended in this reply. To the extent that this rejection may apply to the amended claims, the rejection is respectfully traversed.

The Examiner cites Warren as teaching simulation of a fixed cutter drill bit drilling an earth formation. Warren, however, fails to teach or suggest that which the Ma book lacks. Thus, independent claim 45, as amended, is patentable over the Ma book and Warren, whether considered separately or in combination. Dependent claims 8 and 9 are allowable for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

C. Claims 10-23 and 25-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ma, Warren, and U.S. Patent No. 6,695,073, issued to Glass, *et al.* ("Glass"). Claims 10-23 depend, directly or indirectly, from independent claim 45. Claims 25-35 depend, directly or indirectly, from independent claim 46. Claims 45 and 46 have been amended in this reply. To the extent that this rejection may apply to the amended claims, the rejection is respectfully traversed.

The Examiner cites Glass as disclosing programmed calculations of summed orthogonal cutter faces inclusive of weight-on-bit. Glass, however, fails to teach or suggest that which the Ma book lacks. Thus, independent claims 45 and 46, as amended, are patentable over the Ma book and Glass, whether considered separately or in combination. Dependent claims 10-23 and 25-35 are allowable for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Conclusion

Applicant believes this reply is fully responsive to all outstanding issues and places this application in condition for allowance. If this belief is incorrect, or other issues arise, the Examiner is encouraged to contact the undersigned or his associates at the telephone number listed below. Please apply any charges not covered, or any credits, to Deposit Account 50-0591 (Reference Number 05516/148002).

Dated: June 26, 2007

Respectfully submitted,

By

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Attachments